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TRUCK SHIPPING TESTS WITH LONG ISLAND CAULIFLOWER 1950 - 52.

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Division of Handling, Transportation and
Storage of Horticultural Crops.

Report of a study made under The Research and Marketing Act of 1946, formerly project RM:a 165. Part of the Northeastern Regional project (NEM-3) on studies of merchandising and consumer acceptance, maintenance of quality and condition, and the development of quality tests for vegetables marketed in the Northeast.

New York, N. Y.
April, 1953.

Truck Shipping Tests with Long Island Cauliflower - 1950-52.

INTRODUCTION

During 1950-52 truck shipping tests were made with cauliflower in compliance with Long Island shippers' requests, who, realizing the importance of proper refrigeration, wanted to know what temperatures prevailed under commercial shipping practices and the effect of icing and loading on these temperatures. To fill this need and to recommend commercial practices which will keep deterioration of cauliflower at a minimum, nine truck shipping tests, each of which consisted of two commercial truckloads, were made in cooperation with the Atlantic Commission Company.

METHODS

Two shipments were made in October and November, 1950, four during October, 1951 and 12 during October and November, 1952, all to southern markets. Loading and shipping data on all 18 trucks is presented in table 1. Even though no pair of trucks was shipped to the same destination, the nature of each test was such that fairly accurate comparisons can be made of each pair during the first 48 hours of transit. Discussion of the tests, tables and graphs were therefore largely limited to this 48-hour period. The trailers used in these tests were 29 to 33 feet long, with metal-covered side walls 2 inches thick including insulation. Each trailer contained an ice bunker which remained empty during transit (as was the usual practice). The bunker was situated in the forward end and had a fan at top center driven by a gasoline motor on the outside. The trucks were also equipped with vents which were kept closed. The floors in nine of the trucks had 3/4-inch built-in floor racks; two had removable floor racks, 3/4 and 1 3/4-inches high, respectively; the other seven had none.

The loads were either lengthwise or crosswise. In a lengthwise load the crates were placed lengthwise of the truck, usually 6 wide. In the crosswise load the crates were placed at right angles to the length of the truck, 3 wide, plus one lengthwise row. In both types of loads the crates were loaded on their sides, usually 5 high. These loads were cooled by crushing 300-pound cakes of ice (snow ice) and blowing it on top of the load. The initial icing was made either in Riverhead, Long Island, or in the Newark, New Jersey area. All trucks were reiced several times during the trip, which lasted 48 to about 80 hours. 1/ Temperature records were obtained with recording thermometers placed inside crates in the middle and bottom layers at the centerline in each truck (1950-51 tests) and top, middle, and bottom layers in the forward quarterlength position at the centerline in each truck during the 1952 season. As shown in table 1, the trucks also carried other vegetables in addition to the cauliflower loads of 100 to 365 crates.

1/ Transit period considered ended when the Ryans were removed during unloading.

RESULTS

The temperature data from the 18 trucks are summarized in table 2. The 1952 tests are also illustrated graphically in figures 1 through 6. Terminal data was submitted either by the receiver and/or driver.

1950 tests

Trucks 1 and 2

The two trucks, though shipped from Riverhead on different dates, were loaded during relatively cool weather (50 to 51° F.) when the commodity temperatures averaged 46° and 44° respectively. Truck 1, shipped to Birmingham, Alabama, on October 26, was loaded lengthwise and initially iced in New Jersey. Truck 2, loaded crosswise and shipped to Tampa, Florida, on November 6, was initially iced in Riverhead. Each truck received a total of 31 (9,300 pounds) cakes of ice. Neither truck had floor racks. The fans were on 12 to 15 hours during the transit period of about 3 days (68 to 70 hours). The Ryan thermograph records of the middle and bottom layers indicate excellent temperatures in both trucks, averaging 41° during the first 48 hours and even lower temperatures during the remainder of the trip.

1951 tests

Trucks 3 and 4

Truck 3, shipped to Miami October 16, had no floor racks. The crates were loaded lengthwise. Commodity temperatures at loading averaged 64° F. Initially iced in Riverhead, with several reicings en route, it received a total of 35 cakes of ice. Truck 4, which was shipped to Jacksonville on the same day had 3/4-inch floor racks. The crates were loaded crosswise. Initially iced in New Jersey, it received a total of 44 300-pound cakes of ice. The fans in both trucks failed to operate during most of the trip. Temperature records show (see table 2) that for the first 48 hours after loading the average temperature in Truck 3 was 47° while that of Truck 4 was 57°. The rate of cooling was also faster in the former load, with drops in temperatures of 22 and 13 degrees in middle and bottom layers, respectively, after the first 12 hours. In Truck 4, in the same positions, there was a drop during this period of only 1 degree in the middle layer and a 4 degree rise in the bottom layer due to the delay in initial icing.

Trucks 5 and 6

Truck 5, a lengthwise load, was shipped to Charlotte, North Carolina, on November 19. It was initially iced in Riverhead and additional icing brought the total to 23 cakes. Its fan was or only 23 hours. Truck 6, shipped the same day to Tampa, Florida, with a crosswise load, was initially iced in New Jersey. Additional icings en route brought the total number of cakes to 26. Its fan was on for 40 hours. Each truck was equipped with 3/4-inch floor racks. The cauliflower temperature, which was 58° F. when loaded, dropped

about 10 to 12 degrees in Truck 5 during the first 12 hours. There was practically no cooling (1 to 2 degrees) in Truck 6. For the first 48-hour period the average temperature of the two layers was 47° for the former, or a drop of 11 degrees, and an average of 53° for Truck 6, or a drop of 5 degrees.

It is apparent that trucks 3 and 5, lengthwise load, initially iced at Riverhead had much better temperatures than trucks 4 and 6 which were crosswise loads initially iced in New Jersey. Some of the experiments conducted in 1952 were made to determine how much of this effect on temperature was due to icing and how much was due to method of loading.

1952 tests

Trucks 7 and 8

Both trucks equipped with 3/4-inch racks were loaded lengthwise and were shipped on October 13 with fans operating. The commodity temperatures at the time of loading were 62° F. Truck 7 was shipped to Atlanta, Georgia, after being initially iced in New Jersey. Truck 8, initially iced in Riverhead, was shipped to Tampa, Florida. Each truck received a total of 37 cakes of ice. Temperature records indicate that the load which was iced in Riverhead had decidedly lower temperatures than the load iced in New Jersey After a 48-hour transit period the load iced at Riverhead averaged 9 degrees less at the bottom layer positions than the comparable load iced at New Jersey.

Trucks 9 and 10

These two trucks were shipped on October 17. Both were loaded lengthwise and initially iced in Riverhead. Truck 9, shipped to Asheville, North Carolina, had no floor racks. This truck received a total of 23 cakes of ice. Truck 10, shipped to Tampa, Florida, had 1 3/4-inch floor racks. It received a total of 38 cakes of ice, 15 cakes more than the other truck, because of the greater distance it had to travel. Reference to table 2 shows average temperatures of 45° F. in bottom and middle layers in both loads during a 48 hour-transit period. The records also show the rate of cooling was approximately the same in both trucks.

Trucks 11 and 12

These two trucks were shipped to Miami, Florida, and Charlotte, North Carolina, respectively, on October 27 with fans operating. The commodity temperature of the cauliflower at time of loading averaged 62° F. Both trucks had 3/4-inch built-in floor racks. Truck 11, loaded lengthwise, received a total of 37 cakes of ice; truck 12, loaded crosswise, received 20 cakes. Both loads were initially iced at Riverhead. The cooling in the lengthwise load was somewhat faster than in the crosswise load. The transit temperatures after 48 hours were decidedly better in the lengthwise load (average 46°) than in the crosswise load (average 54°), in the bottom and middle layers.

DISCUSSION

It has been noted in other transit and storage work that most of the yellowing and dropping of leaves of cauliflower has apparently been due to high temperature, as well as such diseases as bacterial soft rot of curd and leaves, Alternaria leaf spot, and watery soft rot. Ramsey 2/ states "many of the leaves of freshly harvested cauliflower placed in storage at 45° F. have been observed to turn yellow and drop within a week regardless of whether they are infected. At 40° the rate of yellowing of the jacket leaves is much slower, and at 32° they do not change much in color within 30 days."

Tests conducted in this laboratory confirm this statement and show that at high temperatures, deterioration is very rapid. Thus, though all the heads in these tests were reported to have arrived in an acceptable condition, probably due to short transit periods, the records show that there were positions (especially in the bottom layers) where temperatures were high enough (over 45° F.) to be considered in the danger zone, possibly shortening the shelf life. This is especially true if the cauliflower is held at non-refrigerated temperatures after unloading.

The 1950 tests show that when the loading temperatures of cauliflower are low (under 45° F.) and cool weather conditions prevail, the present commercial practices are satisfactory for maintaining the temperatures of the load below 45° F.

The 1951 studies indicate that lengthwise loading and initial icing in Riverhead is more desirable than crosswise loading and initial icing in New Jersey. The 1952 results confirm previous findings that better temperatures are obtained through initial icing in Riverhead, and that best refrigeration was obtained with lengthwise loads. The rows in such a load are not apparently as "tight" as those in a crosswise load. The results also indicate that 3/4-inch floor racks (1 3/4-inches in one truck) were probably inadequate to provide good air circulation beneath the load.

The amounts of ice used in these loads were generally sufficient. The terminal reports on some of the trucks, however, show very little ice remaining at destination (an estimated 200 to 300 pounds in trucks 7 and 17) and suggest the need of more ice. The temperature records of truck 16, which arrived with an ample supply of top ice (4 to 6 inches covering the load) but showing rising top layer temperatures, indicate the need of more ice during the first part of the trip than near the end of the trip.

2/ Ramsey, G. B., Wiant, J. S., and Link, G.K. K. Market diseases of Fruits & Vegetables: Crucifers and Cucurbits. U. S. Dept. Agr. Misc. Publ. 292, p. 29. 1938.

SUMMARY

Temperature studies were made in 18 trucks with Long Island cauliflower under various commercial icing and loading practices during October and November, 1950, November, 1951, and October and November, 1952. The most significant facts brought out by the tests were that (1) lengthwise loading is preferable to crosswise loading, (2) such loadings should be initially iced as soon as possible after loading and the second icing made shortly thereafter either in New Jersey or New Castle, Delaware, with additional reicings en route, and (3) in top-iced trucks with vents closed and fans on - 3/4-inch racks (1 3/4-inches in one test) did not permit adequate air circulation beneath the load to cool the bottom layers.

The results of this work indicate the need of lowering temperatures of the bottom layers and suggest tests with top and bunker icing, higher floor racks, and rearrangement of the load for better air circulation.

Table 1. Loading and shipping data
Long Island Cauliflower Truck Shipping Tests 1950-52

Truck No.	1	2	3	4	5	6
Destination	Birmingham Ala.	Tampa, Fla. Jacksonville 1/ Fla.	Miami, Fla.	Jacksonville Fla.	Charlotte N. C. Raleigh 1/ N. C. Asheville 1/ N.C.	Tampa, Fla. Jacksonville 1/ Fla.
	1950		1951			
Date shipped	10/26	11/6	10/16	10/16	10/19	10/19
Date unloaded	10/29	11/9	10/19	10/18	10/21	10/21
Air Temp. Ave. 2/						
Loading	51	50	68	68	65	65
Unloading	68			82		
Commodity Temp. 2/						
Loading	46	44	64	64	58	58
Unloading	38	40	41	42	39	48
Type of load	Lengthwise	Crosswise	Lengthwise	Crosswise	Lengthwise	Crosswise
No. packages per load:						
Cauliflower	100	175	300	350	240	285
Other	315	175	47	65	164	115
Floor racks	No	No	No	Yes	Yes	Yes
Icing:						
Initial	Newark Area N.J.	Riverhead N.Y.	Riverhead N.Y.	Camden N.J.	Riverhead N.Y.	Newark Area N.J.
First Reicing	——	Newark Area N.J.	Newark Area N.J.	Richmond Va.	Newark Area N.J.	Fayetteville N.C.
Total Icing (In pounds "Snow Ice")	9300	9300	10,500	13,200	6,900	7,800
Top Ice Remaining (Estimated in pounds)	-	-	-	2,000	1,000	1,500

1/ Partial unloading at these cities.

2/ Taken manually (by receiver and/or driver at destination).

Table 1. Loading and shipping data. Long Island Cauliflower Truck Shipping Tests 1950-52. (continued)

Truck No.	7	8	9	10	11	12	13	14	15	16	17	18
Destination	Atlanta Ga.	Tampa Fla.	Asheville N.C. Raleigh 1/ Charlotte 1/ N.C.	Tampa Fla. Jackson-ville, Fla. 1/	Miami Fla.	Charlotte N.C. Raleigh 1/ N.C.	Asheville N.C. Charlotte 1/ N.C.	Tampa Fla.	Tampa Fla. Jackson-ville, Fla. 1/	Miami Fla.	Miami Fla.	Jacksonville Fla.
	1952											
Date shipped	10/13	10/13	10/17	10/17	10/27	10/27	10/27	10/27	10/31	10/31	11/3	11/3
Date unloaded	10/16	10/16	10/19	10/20	10/30	10/29	10/29	10/30	11/3	11/3	11/6	11/5
Air Temp. Ave. 2/												
Loading	68	68	58	58	63	61	65	63	65	65	61	61
Unloading	59	75	46	70	78			50		74	70	
Commodity Temp. 2/												
Loading	62	62	56	56	62	62	58	50	52	52	61	61
Unloading	54	50	47	48	40	48	39	40	47	60	46	42
Type of load	Lenth-wise	Length-wise	Length-wise	Length-wise	Length-wise	Cross-wise	Length-wise	Cross-wise	Cross-wise	Cross-wise	Length-wise	Cross-wise
No. packages per load:												
Cauliflower	325	300	275	301	300	175	365	175	275	350	250	290
Other	75	125	125	75	105	125	60	200	120	-	95	90
Floor racks	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Icing:												
Initial	Newark Area N.J.	River-head, N.Y.	Riverhead N.Y.	Riverhead N.Y.	River-head, N.Y.	Riverhead N.Y.	Riverhead N.Y.	River-head, N.Y.	Riverhead N.Y.	River-head, N.Y.	River-head, N.Y.	Riverhead N.Y.
First Reicing	Rich-mond, Va.	Newark Area, N.J.	NewCastle Del.	NewCastle Del.	Newark Area, N.J.	NewCastle Del.	NewCastle Del.	New Castle Del.	NewCastle Del.	Smith-field, N.C.	New Castle Del.	NewCastle Del.
Total Icing (In pounds "Snow Ice")	11,100	11,100	6,900	11,400	11,100	6,000	9,000	8,400	10,200	8,400	7,500	10,500
Top Ice Remaining (Estimated in pounds)	200	500	1,000	600	1,500	-	2,000	800	1,500	1,000	300	2,000

1/ Partial unloading at these cities.

2/ Taken manually (by receiver and/or driver at destination).

Table 2. Temperatures in transit as influenced by type of load, icing and floor racks.

Test No.	Date shipped	Truck No.	Type of load	Initial icing	Floor racks	Location of Ryan in load (layer)	Temperatures in transit --Hours after loading-- 0 °F.	6 °F.	12 °F.	18 °F.	24 °F.	30 °F.	36 °F.	42 °F.	48 °F.	54 °F.	60 °F.	66 °F.	72 °F.	Average first 48 hours ° F.
1	10/26/50	1	Length-wise	Newark Area, N. J.	No	Middle	46	42	42	43	43	39	39	39	34	33	33	33	33	41
						Bottom	46	42	42	41	41	40	41	40	39	38	39	39	40	41
	11/6/50	2	Cross-wise	River-head, N.Y.	No	Middle	44	46	43	41	41	38	36	37	38	38				41
						Bottom	44	44	43	41	41	40	38	38	39	39				41
2	10/16/51	3	Length-wise	River-head, N. Y.	No	Middle	64	55	42	43	39	37	38	38	37	35	35			44
						Bottom	64	60	51	51	49	44	44	45	45	45	44			50
	10/16/51	4	Cross-wise	Camden, N. J.	Yes	Middle	64	66	63	66	50	47	47	47	47	48				55
						Bottom	64	65	68	69	59	50	50	52	52	52				59
3	10/19/51	5	Length-wise	River-head, N. Y.	Yes	Middle	57	43	45	45	45	44	43	43	43	41	41			45
						Bottom	59	53	49	48	47	46	46	45	43	39	39			48
	10/19/51	6	Cross-wise	Newark Area, N. J.	Yes	Middle	57	55	55	50	49	44	44	45	45	42	43			49
						Bottom	59	60	58	55	57	58	56	57	54	52	52			57

Table 2. Temperatures in transit as influenced by type of load, icing and floor racks. (continued)

Test No.	Date shipped	Truck No.	Type of load	Initial icing	Floor racks	Location of Ryan in load (layer)	Temperatures in transit --Hours after loading-- 0 °F.	6 °F.	12 °F.	18 °F.	24 °F.	30 °F.	36 °F.	42 °F.	48 °F.	54 °F.	60 °F.	66 °F.	72 °F.	Average first 48 hours ° F.
4	10/13/52	7	Length-wise	Newark Area, N. J.	Yes	Top	Instrument failed to record.													
						Middle	63	65	58	60	60	59	54	53	52	51	49	49	49	58
						Bottom	62	62	61	61	60	59	58	57	57	57	57	57	57	60
	10/13/52	8	Length-wise	River-head, N. Y.	Yes	Top	61	46	39	40	39	39	38	36	35	35	43	43	43	41
						Middle	62	50	45	45	44	43	43	43	44	44	43	42	43	46
						Bottom	62	56	52	52	52	53	53	52	53	53	46	48	48	54
5	10/17/52	9	Length-wise	River-head, N. Y.	No	Top	56	44	40	37	37	34	33	33	33	33				39
						Middle	57	48	44	42	42	40	40	40	40	40				44
						Bottom	55	49	43	43	42	43	44	45	46	45				46
	10/17/52	10	Length-wise	River-head, N. Y.	Yes	Top	56	43	40	42	47	46	45	43	40	47	51	58		45
						Middle	56	46	39	39	41	42	43	43	43	43	47	49		44
						Bottom	54	47	43	43	42	43	44	45	45	43	38	40		45
6	10/27/52	11	Length-wise	River-head, N. Y.	Yes	Top	61	46	44	44	45	43	40	41	38	37	36	36		45
						Middle	63	46	40	39	40	41	40	40	39	35	33	32		43
						Bottom	61	54	50	48	49	46	45	44	42	41	40	39		49
	10/27/52	12	Cross-wise	River-head, N. Y.	Yes	Top	62	51	52	50	48	45	45	45	42					49
						Middle	63	56	54	54	54	54	55	54	52					55
						Bottom	61	57	57	55	55	53	48	45	44					53

Table 2. Temperatures in transit as influenced by type of load, icing and floor racks. (continued)

Test No.	Date shipped	Truck No.	Type of load	Initial icing	Floor racks	Location of Ryan in load (layer)	Temperatures in transit --Hours after loading-- 0 °F.	6 °F.	12 °F.	18 °F.	24 °F.	30 °F.	36 °F.	42 °F.	48 °F.	54 °F.	60 °F.	66 °F.	72 °F.	Average first 48 hours ° F.
7	10/27/52	13	Length-wise	River-head, N. Y.	No	Top	59	55	34	Instrument failed to record.										
						Middle	59	56	49	47	46	42	39	37	37					46
						Bottom	58	57	53	52	51	49	46	43	39					50
	10/27/52	14	Cross-wise	River-head, N.Y.	No	Top	58	50	44	44	43	40	39	37	37	34	34			44
						Middle	57	54	53	52	52	48	48	48	46	40	40			51
						Bottom	58	53	55	53	53	50	49	45	45	42	43			51
8	10/31/52	15	Cross-wise	River-head, N.Y.	No	Top	52	46	42	40	34	34	33	33	34	40	40			39
						Middle	52	51	50	50	39	38	36	36	36	38	38			43
						Bottom	52	51	53	54	55	56	56	54	55	55				54
	10/31/52	16	Cross-wise	River-head, N. Y.	Yes	Top	52	50	47	52	55	55	55	57	59	60	61			54
						Middle	51	52	54	56	58	60	61	62	62	62				57
						Bottom	52	51	50	46	38	38	38	38	40	40	42			43
9	11/3/52	17	Length-wise	River-head, N. Y.	Yes	Top	62	46	39	40	40	40	41	41	41	41	41	39		43
						Middle	61	47	40	42	41	41	41	42	41	41	41			44
						Bottom	61	54	47	48	47	47	47	46	45	45	45	46		49
	11/3/52	18	Cross-wise	River-head, N. Y.	Yes	Top	61	51	47	47	45	45	45	45	45					48
						Middle	62	54	52	46	47	44	45	42	42					48
						Bottom	61	61	57	57	54	53	48	49	49					54

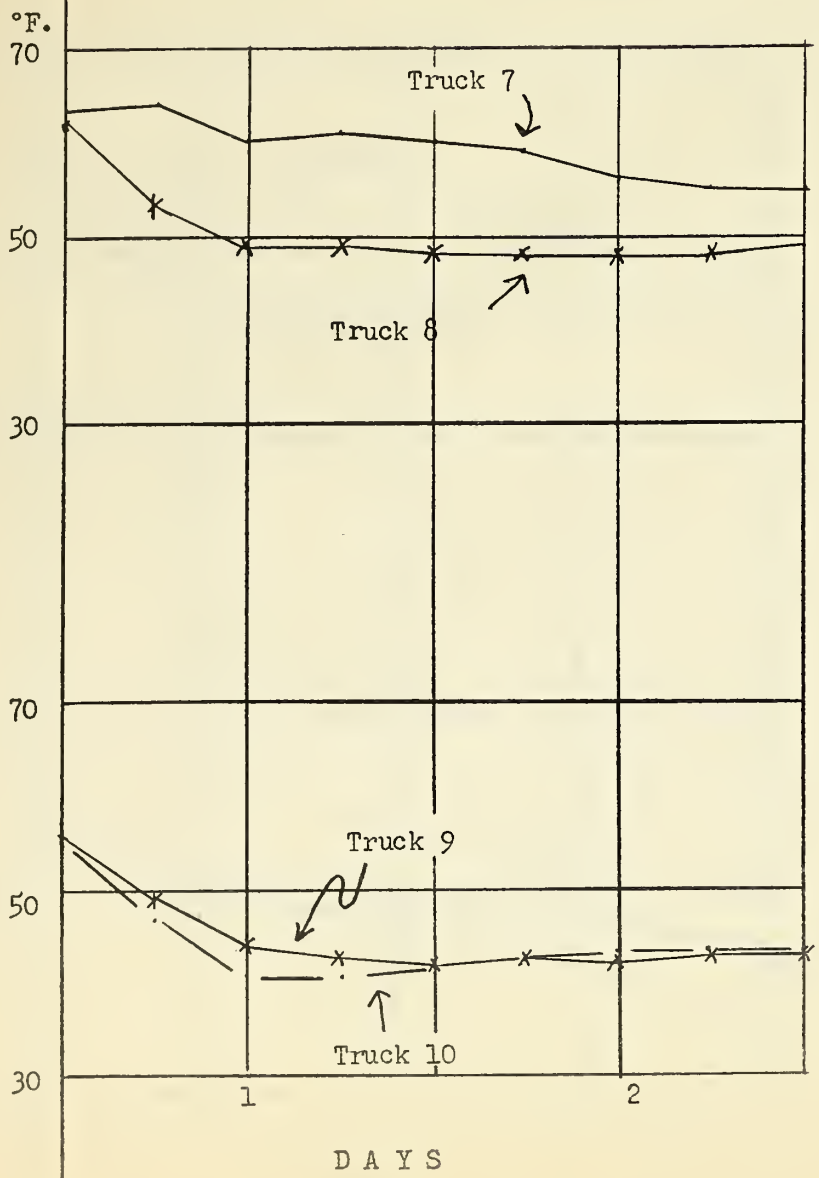
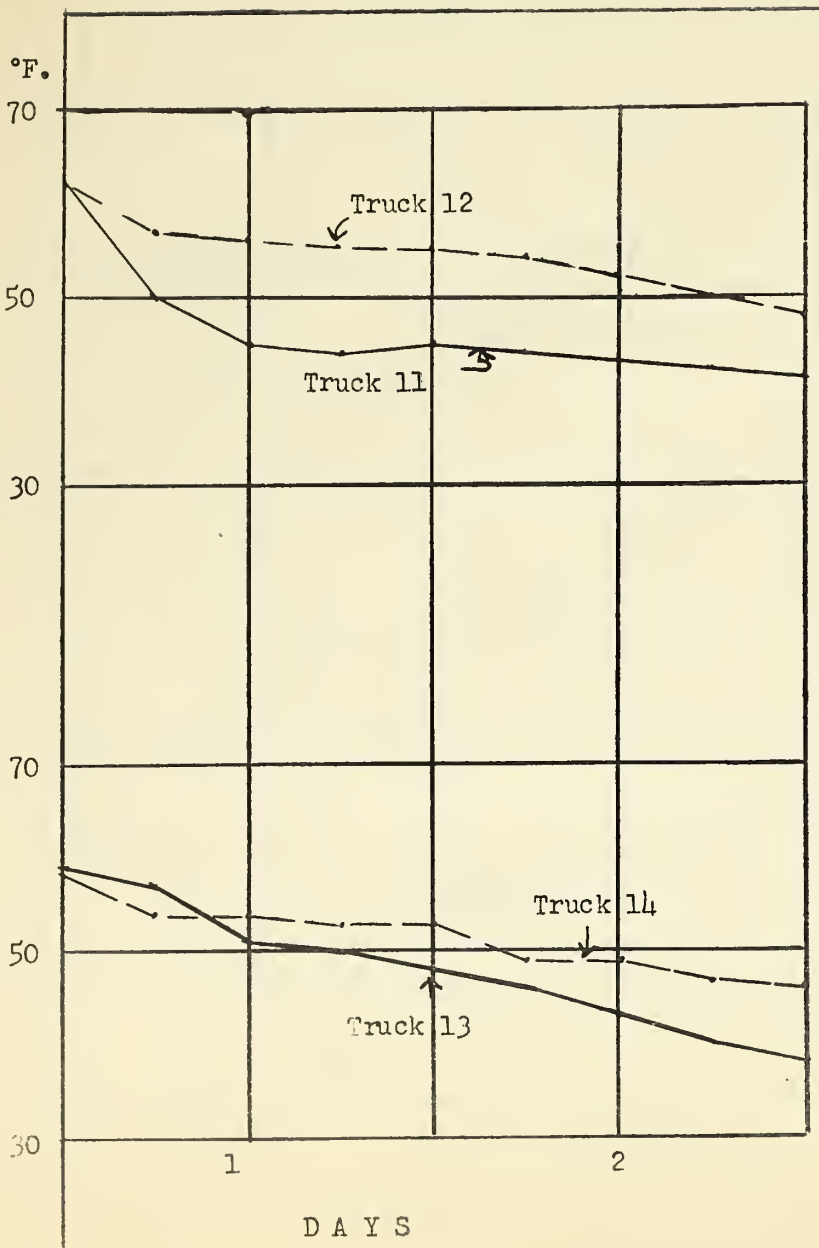


Figure 1.

Comparison of initial icing at Riverhead, N. Y. vs. initial icing at Newark, N. J. area.
Both lengthwise loads without floor racks.
Truck 7 initially iced at Newark Area, N. J.
Truck 8 " " " Riverhead, N. Y.
Average truck temperature of two positions.
October 1952.

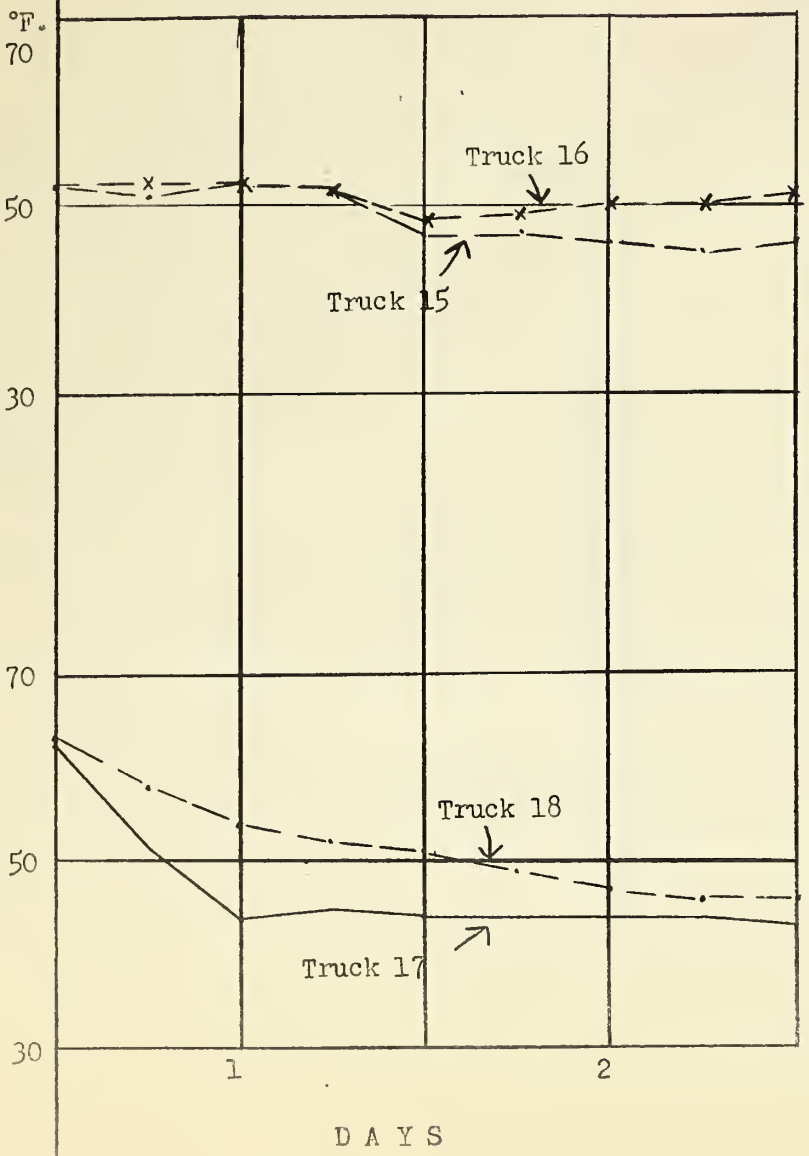
Figure 2.

Comparison of floor racks vs. no floor racks.
Both loaded lengthwise and initially top iced at Riverhead.
Truck 9 without floor racks.
Truck 10 with floor racks.
Average truck temperature of three positions.
October 1952.



Figures 3 and 4.

Comparison of lengthwise vs. crosswise loading.
All initially top iced at Riverhead.
Trucks 11 and 12 with floor racks.
Trucks 13 and 14 without " " .
Trucks 11 and 13 lengthwise load.
Trucks 12 and 14 crosswise load.
Average truck temperature of three positions.
October 1952.



Figures 5 and 6

Comparison lengthwise vs. crosswise loading. All initially top iced at Riverhead, N. Y. Trucks 16, 17 and 18 with floor racks, truck 15 without floor racks. Trucks 15, 16 and 18 crosswise loads, truck 17 lengthwise load. Average truck temperature of three positions. October November 1952.